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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/050,322	01/15/2002	Ming Huan Tsai	67,200-613	3498

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EXAMINER
BARRECA, NICOLE M

ART UNIT	PAPER NUMBER
1756	2

DATE MAILED: 06/23/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/050,322	TSAI ET AL.	
	Examiner	Art Unit	
	Nicole M. Barreca	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. Claims 1-20 are pending in this application.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 4 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 4 is unclear as to the amounts of each gas required in the mixture. Are oxygen and argon required to be present if there are 100 parts nitrogen? Is there suppose to be 3-100 parts of argon, or is the total mixture to be 3-100 parts?

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1, 3, 5-7 are rejected under 35 U.S.C. 102(e) as being anticipated by Shibata (US 2002/0036183).

6. Shibata discloses a method for forming a pattern. Silicon oxide film 22 is formed over silicon substrate 1. A lower resist film 23 of 900 nm is formed on the silicon oxide

surface, followed by an upper resist film 24 of 200 nm (2000 angstroms) of a chemically amplified positive resist. The coated film is exposed, developed and subjected to a silylation process to form a silicon containing photoresist. A polysilsequioxane solution is coated on the surface of the upper resist pattern 24, which forms polysilsequioxane film 25. The polysilsequioxane film 25 is developed using TMAH to form polysilsequioxane film pattern 26. Polysilsequioxane film pattern 26 is used as a mask to form lower resist pattern 27 by a dry etch process using a N2/O2 mixed plasma [0107]-[0117]. KrF, ArF (193 nm), Xe and F2 (157 nm) lasers may be used for the resist exposure [0148]. Example 6 teaches an example wherein the non-silicon containing resist layer has a thickness of 500 nm (5000 angstroms) [0129]. The patterning method may be used to form a gate electrode, isolation trench or trench capacitor by etching layers such as polysilicon, metal or tungsten [0146].

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 2 and 4 rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata as applied to claim 1 above, and further in view of Smith (US 6,388,226).

9. The teachings of Shibata have been discussed above. Shibata teaches a patterning method using a silicon containing upper resist layer and a non-silicon containing lower resist layer, wherein the non-silicon containing layer is dry etched

using a plasma of N2/O2. Shibata however is silent on the specific etching conditions and does not disclose having an RF power source for plasma excitation and acceleration towards the substrate surface. Smith teaches that RF inductively coupled plasmas are particularly useful for generating large area plasmas for such applications as semiconductor wafer processing and for producing high energy ions wherein the plasma is in direct contact with material being processed (col.2, 14-34). It would have been obvious to one of ordinary skill in the art to use a RF power source for the plasma excitation and acceleration to the substrate surface in the method of Shibata because Smith teaches that RF power sources are particularly useful generating plasmas for semiconductor manufacturing applications and for plasmas which are in direct contact with material surface.

Shibata does not disclose having argon in the plasma mixture or the specific amounts of oxygen, nitrogen and argon in the plasma. Smith teaches that adding a noble gas such as argon to a mixture of O2 and N2 will allow the reactive species to be more efficiently transported and therefore will increase the photoresist removal rate (col.15, 29-65). It would have been obvious to one of ordinary skill in the art to add argon to the N2/O2 plasma mixture in the method of Shibata because Smith teaches that adding a noble gas such as argon to a mixture of O2 and N2 will allow the reactive species to be more efficiently transported and therefore will increase the photoresist removal rate. Smith is silent on the amounts of each gas. However the amount of reactive gases in a plasma etching mixture is a result effective variable which would affect the etching rate. It would be within the ordinary skill of one in the art to determine

the optimal amounts of each gas in the method Shibata in view of Smith by routine experimentation because the discovery of an optimum value of a result effective variable is ordinary within the skill of the art, as taught by *In re Boesch* (617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

10. Claims 8-13, 18, 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata in view of Smith as applied to claim 2 above, and further in view of Fujimura (US 4,938,839).

11. Shibata teaches a patterning method using a silicon containing upper resist layer and a non-silicon containing lower resist layer, wherein the non-silicon containing layer is dry etched using a plasma of N2/O2 and which then may be used to form a gate electrode, isolation trench or trench capacitor by etching layers such as polysilicon, metal or tungsten. Shibata in view of Smith does not disclose ashing steps for removing the silicon containing photoresist and the non-silicon containing photoresist which use an oxygen plasma including at least one of nitrogen and fluorine ions. Fujimura teaches that good removal of photoresist is confirmed when argon or nitrogen gas is added to oxygen gas for stabilizing the plasma production and a fluoride gas such as carbon tetrafluoride gas may be added to the oxygen gas for promotion the reaction (col.4, 55-60). It would have been obvious to one of ordinary skill in the art to remove the silicon containing and non-silicon containing photoresist layers using an oxygen plasma including at least one of nitrogen and fluorine ions in the method of Shibata in view of Smith because Fujimura teaches that that good removal of photoresist is confirmed when argon or nitrogen gas is added to oxygen gas for stabilizing the plasma production

and a fluoride gas such as carbon tetrafluoride gas may be added to the oxygen gas for promotion the reaction.

The references do not explicitly disclose that the dry developing steps, the first and second ashing steps, the RIE step and the cleaning step are carried out in the plasma reactor in a continuous process. However it would have been obvious to one of ordinary skill in the art to perform all of the plasma processing steps in a continuous process because it is known in the art that this will decrease the processing time required for the semiconductor devices being manufactured.

12. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata in view of Smith and Fujimura as applied to claim 13 above, and further in view of Coburn (US 4,226,896).

Fujimura is silent on the specific plasma conditions and does not disclose maintaining the oxygen containing plasma at about 5-1000 mT, a first RF power source of about 200-5000 W or a second RF power source of about 50-500 W. Coburn teaches that the parameters of a plasma process, such as the frequency of the applied voltage, the excitation power, the pressure and gas flow rate can be adjusted or varied to control the etch rate (col.3, 2-8), and are therefore result effective variables. It would within the ordinary skill of one in the art to determine the optimal conditions for the oxygen containing plasma in the method Shibata in view of Smith and Fujimura by routine experimentation and to have a pressure of about 5-1000 mT, a first RF power source of about 200-5000 W and a second RF power source of about 50-500 W, if required, because Coburn teaches that the frequency of the applied voltage, the

excitation power, the pressure and gas flow rate are result effective variables and the discovery of an optimum value of a result effective variable is ordinary within the skill of the art, as taught by *In re Boesch* (617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

13. Claims 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata in view of Smith and Fujimura as applied to claim 13 above, and further in view of Geffken (US 6,426,249).

14. The references do not disclose performing an RIE process through a metal nitride layer using a hydrofluorocarbon containing plasma. Geffken teaches that silicon nitride layers are conventionally etched in semiconductor processing using perfluorocarbon or hydrofluorocarbon gases (col.3, 41-45). It would have been obvious to one of ordinary skill in the art to etch a silicon nitride layer using hydrofluorocarbon gases in the method of Shibata in view of Smith and Fujimura because Geffken teaches that hydrofluorocarbon gases are conventionally used to etch silicon nitride layers in semiconductor manufacturing.

15. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata in view of Smith, Fujimura and Geffken as applied to claim 16 above, and further in view of Coburn (US 4,226,896).

Fujimura is silent on the specific plasma conditions and does not disclose maintaining the oxygen containing plasma at about 5-1000 mT, a first RF power source of about 200-5000 W or a second RF power source of about 50-500 W. Coburn teaches that the parameters of a plasma process, such as the frequency of the applied voltage, the excitation power, the pressure and gas flow rate can be adjusted or varied

to control the etch rate (col.3, 2-8), and are therefore result effective variables. It would within the ordinary skill of one in the art to determine the optimal conditions for the oxygen containing plasma in the method Shibata in view of Smith, Fujimura and Geffken by routine experimentation and to have a pressure of about 5-1000 mT, a first RF power source of about 200-5000 W and a second RF power source of about 50-500 W, if required, because Coburn teaches that the frequency of the applied voltage, the excitation power, the pressure and gas flow rate are result effective variables and the discovery of an optimum value of a result effective variable is ordinary within the skill of the art, as taught by *In re Boesch* (617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

16. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata in view of Smith and Fujimura as applied to claim 10 above, and further in view of Conti (US 6,570,256).

17. Shibata (in view of Smith and Fujimura) teaches a silicon oxide layer underlying the bi-layer resist stack and does not disclose etching through an insulating layer with a dielectric constant of less than 3. Conti teaches that low-k dielectric layers, such as those with a dielectric constant of 2.7, create less capacitance between and around conductors and are more easily applied than conventional silicon oxides having higher dielectric constants (col.1, 14-25). It would have been obvious to one of ordinary skill in the art to use an insulating layer with a dielectric constant of less than 3, instead of silicon oxide, in the method of Shibata (in view of Smith and Fujimura) because Conti teaches that that low-k dielectric layers, such as those with a dielectric constant of 2.7,

create less capacitance between and around conductors and are more easily applied than conventional silicon oxides having higher dielectric constants.

Conclusion

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nicole M. Barreca whose telephone number is 703-308-7968. The examiner can normally be reached on Monday-Thursday (8:00 am-6: 30 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 703-308-2464. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Nicole Barreca
Patent Examiner
Art Unit 1756

June 16, 2003